

A GENERIC REVISION OF THE EUCHLOINI  
(LEPIDOPTERA, PIERIDAE).

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INTRODUCTION.

Ever since entomologists first began to study the *Euchloini* with the generic classification of the group in mind, there has been much discussion on the subject, and there have been nearly as many different combinations of the species into different genera as there have been papers published. To one viewing all of this in retrospect the reason is evident, namely that most of the workers have placed their main reliance on the wing venation as a guide in determining the limits and relationships of the genera. Other workers in turn have realized that the venation was so variable that it was not at all suitable as a character for generic work, and these adopted the procedure of grouping all or nearly all of the species into one or two large genera, discounting not only the venation but also almost all other characters.

The writer undertook the study of the *Euchloini* in the hope that a study of the male genitalia might bring to light reliable generic characters. This has proved to be the case. These structures show none of the individual variation that makes the venation so untrustworthy. They furnish excellent grouping characters and appear, in most cases, to show excellent though never very great specific characters. The writer feels that in view of this lack of variation more confidence is to be placed in the structures of the genitalia than in the extremely variable venation, and has accordingly placed his main reliance in them. Other characters, however, have been by no means excluded.

Considerable use has been made of subgenera in an attempt to produce a system of classification which will seem in some degree natural, and to do away with that bane of most taxonomists, the long list of very small genera. Such use of subgenera can itself

be carried too far, of course, but when used in moderation it appears to offer undoubted advantages which are too obvious to need discussion.

*Explanation of Terms.*

(See figures.)

In the structure of the male genitalia the *Euchloini* differ from most of the other *Pieridae* in possessing a flat curved *clasper* (cl) located on the inner face of the *harpé* (h). The *harpé* is comparatively simple, and has a smooth rounded termination. In many of the species its dorsal margin bears, at about the middle, a *dorsal spine* (d. s.) which may extend dorsad or may be curved inward and down between the harpés. The line of separation between the *tegumen* (t) and the *uncus* (u) is quite distinct. The *uncus* is sometimes distinctly swollen laterally at the base. The *tegumen* is occasionally swollen laterally just cephalad of the base of the *uncus* (fig. 6). The *vinculum* (v) is dorsally entire, though considerably narrowed. The *saccus* (sac) is in some cases fairly long and slender (fig. 4), but in others is very short and thick (figs. 7, 9). A small shield-shaped *juxta* (jux) is always present, although in some species very small. The *penis* (p) is rather short and is basally curved, sometimes strongly so (fig. 9). It bears near the base an area of heavier chitinization, and may in addition have a small rounded *basal prong* (b. p. p.—figs. 8-9).

GENERIC SYNONYMY AND CHARACTERS—SPECIES LISTS.

In the lists of species included in the various groups those names preceded by a question mark are species which the writer has not had the opportunity of examining, but which have been included on the basis of similarity in color and pattern to species which he has examined. No attempt has been made at revising the synonymy of the species. The synonymy of Röber (1906, 1910) has been followed in this respect, even though changes in synonymy have more recently been advocated, since his is the most recent work treating of the entire group. Races have been included in the list where there seems to be a possibility of their constituting distinct species.

Bibliographic references will be found at the end of the article. To avoid repetition none have been given in full in either the text or the lists. Only the most important and complete revisions

have been included, since most of the local or fragmentary lists published have no significance in a study of the group as a whole.

*Anthocharis* Boisduval 1832, type *cardamines* L.

Generic characters: Males with apex of primary with an orange patch (except *lanceolata* Boisd.);  $R_2$  arising from cell; dorsal margin of harpé evenly curved, bearing no structures; clasper simple, rounded; uncus slender, slightly if at all swollen at base, with no dorsal prominences; saccus more than twice as long as thick.

Subgenus *Anthocharis* Boisd. 1832, type *cardamines* L.

- < *Papilio* Linnaeus 1761
- < *Euchloë* Hübner 1816
- < *Anthocharis* Boisduval 1832
- < *Anthocharis* de Villiers & Guénée 1835
- < *Anthocharis* Boisduval 1836
- < *Anthocharis* sect. II Doubleday 1846
- < *Euchloë* Butler 1870
- = *Euchloë* Kirby 1873
- = *Euchloë* Scudder 1875
- < *Euchloë* Kirby 1875
- < *Anthocharis* Schatz 1892
- < *Euchloë* Beutenmüller 1898
- > *Euchloë* Grote 1898
- < *Euchloë* Butler 1898a
- < *Euchloë* Butler 1898b
- < *Euchloë* Grote 1900
- < *Euchloë* Verity 1905
- < *Anthocharis* Rober 1906 & 1910

Subgeneric characters: Apex of primary rounded, never falcate.

Species included:

- cardamines* L.
- ? *bambusarum* Oberthür
- gruneri* Herrich-Schäffer
- damone* Boisduval
- eupheno* L.
- euphenooides* Staudinger
- sara* Boisduval
- cethura* Felder
- pima* Edwards

Subgenus **Falcapica**, nomen nov., type *genutia* Fabricius.

- < *Papilio* Fabricius 1793
- < *Euchloë* Hübner 1816
- < *Anthocharis* Boisduval 1836
- < *Anthocharis* sect. II Doubleday 1846
- > *Midea* Herrich-Schäffer 1867 (*nec Midea* Bruzelius 1854)
- < *Euchloë* Butler 1870
- = *Euchloë* Scudder 1872
- = *Anthocharis* Scudder 1875
- = *Midea* Scudder 1875
- > *Midea* Kirby 1875
- = *Midea* Schatz 1892
- < *Euchloë* Beutenmüller 1898
- < *Euchloë* Holland 1898
- < *Euchloë* Grote 1898
- < *Euchloë* Butler 1899 a & b
- = *Midea* Grote 1900
- < *Euchloë* Staudinger & Rebel 1901
- < *Synchloë* Dyar 1902
- < *Euchloë* Verity 1905
- = *Midea* Röber 1906-10

Subgeneric characters: Apex of primary falcate, sometimes strongly so.

Species included:

- genutia* Fabricius
- lanceolata* Boisduval
- bieti* Oberthür
- scolymus* Butler

*Anthocharis* Boisduval was first proposed in 1832 with *cardamines* as the sole species included, so that *cardamines* automatically became the genotype. The genus was first based on larval characters, which is possibly the reason for the fact that it has been almost universally attributed to Boisduval in the "Species Général" of 1836. In this latter work it includes a long list of species of which *genutia* Fabr. is one. From this probably arose Scudder's belief that *genutia* was available for the genotype.

*Midea* Herrich-Schäffer was proposed with *genutia* as the sole species included, so that *genutia* automatically became the genotype. *Midea* Herrich-Schäffer is, however, a homonym of *Midea* Bruzelius 1854. See also *Midea* Walker 1863.

The species here included in the genus *Anthocharis* are all very similar to each other in the structure of the genitalia. Specific

differences are present, but are slight. Previous authors who have grouped these species into two or more genera or subgenera have usually based their action on the venation. As pointed out by Butler (1899b) and as a careful study of an adequate series of specimens will show, such a proceeding is extremely unwise, due to the great amount of individual variation found in the venation of a number of the species. The writer has therefore made use of the falcate apex of the primary as being the only major character not subject to variation and giving reasonable results.

Of the species here placed in the subgenus *Anthocharis*, the females of *cardamines*, *gruneri* and *damone* lack orange on the apex of the primary above, while the females of the other species possess orange in this area. Obviously the use of this character, which would separate *gruneri* and *damone* from *eupheno* and *euphenoides*, is not to be considered.

Nor can use be made of the number of radials in the primary, for in this respect *sara* is quite variable (Butler 1899b), *cethura* and *pima* constantly possess four, and the other species five. Of the species here placed in *Falcapica*, *lanceolata* varies considerably in the number of the radials. About half of the specimens of this species which the writer has examined possess five radials on either one or both wings, although  $R_5$  is always very short. This variation in *lanceolata* was also noticed and commented upon by Butler (1899b).

*Zegris* Rambur 1836, type *eupheme* Esper.

Generic characters: Apex of primary of male with an orange patch, usually very narrow; apical markings of primary extending never more than slightly over halfway from apex to end of cell; dorsal margin of harpé at about middle produced dorsad in the form of a triangular flap or tooth; saccus never twice as long as thick, sometimes as thick as long; penis lightly bent near base, with a basal heavier chitinization but no basal prong.

Subgenus *Zegris* Rambur 1836, type *eupheme* Esp.

< *Papilio* Esper 1805

< *Anthocharis* de Villiers & Guénée 1835

> *Zegris* Rambur 1836

> *Zegris* Boisduval 1836

> *Zegris* Doubleday 1846

> *Zegris* Butler 1870

= *Zegris* Scudder 1875

- > *Zegrís* Kirby 1875
- = *Zegrís* Schatz 1892
- < *Zegrís* Butler 1899a
- < *Zegrís* Butler 1899b
- = *Zegrís* Grote 1900
- = *Zegrís* Staudinger & Rebel 1901
- = *Zegrís* Verity 1905
- < *Zegrís* Röber 1906

Subgeneric characters: Primary with 5 radials,  $M_1$  stalked on  $R_s$  usually more than halfway from cell to base of  $R_3$ ;  $R_2$  usually stalked on  $R_s$ , very seldom arising from end of cell; dorsal margin of harpé at middle produced to form a larger flap than in subgenus *Microzegrís*; clasper somewhat narrowed at middle; saccus very short, little if any longer than thick.

Species included:

- eupheme* Esper
- fausti* Christoph

Subgenus *Microzegrís* Alpheraky 1913, type *pyrothoë* Eversmann.

- < *Pontia* Eversmann 1832
- < *Anthocharis* De Villiers & Guénée 1835
- < *Zegrís* Boisduval 1836
- < *Zegrís* Doubleday 1846
- < *Euchloë* Butler 1870
- < *Euchloë* Kirby 1875
- < *Anthocharis* Schatz 1892
- < *Euchloë* Staudinger & Rebel 1901
- < *Euchloë* Verity 1905
- < *Euchloë* Röber 1906 & 1910
- = *Microzegrís* Alpheraky 1913
- = *Pyrothoia* Verity 1929

Subgeneric characters: Primary with 4 radials,  $R_5$  missing;  $M_1$  stalked on  $R_s$  usually less than halfway from cell to base of  $R_3$ ;  $R_2$  usually arising from end of cell; dorsal margin of harpé at middle bearing a very small tooth; clasper very slightly narrowed at middle; saccus considerably longer than thick.

Species included:

- pyrothoë* Eversmann

*Zegrís* has been almost constantly held as a distinct genus, perhaps more because of the peculiar structure of the pupa and extraordinary method of pupation as described by Rambur (1836)

than because of any other characters. Recently some doubt has arisen as to the accuracy of Rambur's statements (Riley 1926), although the writer is not aware of any definite proof one way or the other. For this reason the pupal characters have been omitted from the above list of subgeneric characters. The writer considers that even should the pupation of *Zegris* be proven to be normal the species would still be worthy of generic separation on other grounds.

The shorter, more abruptly clubbed antennae, bushier palpi and heavier vestiture have been also frequently cited as generic characters for *Zegris*. These characters do not appear very distinct, although worth passing mention. Butler (1899a) placed *cethura* and *pima* in *Zegris* on the antennal character and (1899b) placed *olympia* in *Zegris* for the same reason in addition to pattern similarities. In his placing of *olympia* he has been followed by subsequent authors. Except in the matter of the antennae *cethura* and *pima* are evidently closely related to the species of *Anthocharis*, where the present author has placed them. *Olympia* shows close relationship to the species of *Euchloë* and accordingly has been placed there for the present. It does, however, seem to be more closely related to *Zegris* than are the other species of *Euchloë*, and probably represents somewhat of a transitional form. The life history of *olympia* is perfectly normal, showing none of the peculiarities described by Rambur for *Zegris* (Shull 1907).

*Pyrothoë* shows distinct differences from *eupheme* and *fausti* as cited in the subgeneric characters. The writer accordingly feels that *Microzegris* is worth retaining as a subgenus, although it is certainly not to be regarded as a distinct genus. The original proposal of *Microzegris* is, incidentally, very obscure, and appears to have been missed by all reviewers. It constitutes a beautiful example of the fact that when new names are proposed the author should emphasize the fact in every way possible.

*Euchloë* Hübner 1816, type *belia* Cramer.

Generic characters: Apex of primaries never with orange patch; primary normally with five radials;  $M_1$  normally arising halfway from cell to base of  $R_3$ ; middle discocellular of primary normally short; dorsal margin of harpé at about middle produced to form a strong pointed flap or tooth; penis strongly curved near base; saccus always longer than thick.

Subgenus *Euchloë* Hübner 1816, type *belia* Cramer.

< *Papilio* Cramer 1782

< *Euchloë* Hübner 1816

- < *Anthocharis* de Villiers & Guénée 1835
- < *Anthocharis* Boisduval 1836
- < *Anthocharis* sect. II Doubleday 1846
- < *Euchloë* Butler 1870
- < *Euchloë* Kirby 1875
- < *Phyllocharis* Schatz 1892
- < *Euchloë* Beutenmüller 1898
- < *Euchloë* Holland 1898
- < *Anthocharis* Grote 1898
- < *Euchloë* Butler 1899a
- < *Euchloë* Butler 1899b
- < *Anthocharis* Grote 1900
- < *Euchloë* Staudinger & Rebel 1901
- < *Synchloë* Dyar 1902
- < *Euchloë* Verity 1905
- < *Euchloë* Röber 1906-10

Subgeneric characters: Ground color of wings always white (creamy white in some female forms); dark markings of secondaries beneath not normally so heavy as to cover practically all of wing; pointed flap of dorsal margin of harpé long, heavily chitinized, projecting dorsad, then bent mesad and ventrad with termination between harpés; penis not so strongly bent basally as in subgenus *Elphinstonia*, with no basal prong; larva apparently not so strongly tuberculate as larva of *Elphinstonia*.

Species included:

- belia* Cramer
- orientalis* Bremer
- daphalis* Moore
- ? *venosa* Boisduval
- ausonides* Boisduval
- creusa* Doubleday & Hewitson
- olympia* Edwards
- belemia* Esper
- ? *seitzi* Röber
- falloui* Allard

Subgenus nov. **Elphinstonia**, type *charlonia* Donzel.

- = *Anthocharis* Donzel 1842
- < *Anthocharis* sect. II Doubleday 1846
- < *Euchloë* Kirby 1875
- < *Phyllocharis* Schatz 1892
- < *Euchloë* Staudinger & Rebel 1901



< *Euchloë* Verity 1905

< *Anthocharis* Röber 1906-10

Subgeneric characters: Ground color of wings white or yellow; dark markings of secondaries beneath heavy, often covering practically all of wing; pointed flap of dorsal margin of harpé shorter and less heavily chitinized than in subgenus *Euchloë*, extending above dorsal margin of harpé, not bent mesad and ventrad; penis very strongly bent basally, with a short blunt basal prong; larva apparently somewhat more heavily tuberculate than larva of *Euchloë*.

Species included:

*charlonia* Donzel

? *c. tomyris* Christoph

? *c. pechi* Staudinger

*tagis* Hübner

? *lucilla* Butler

The first type specification for *Euchloë* which the writer has been able to find is of *belia* Cramer by Butler (1870). Accordingly *belia* is here placed as the genotype. The fact that previous to this date various authors had used *Euchloë* to include *cardamines* alone in local lists does not fix *cardamines* as the genotype, as was claimed by Kirby (1872) and Scudder (1875).

Schatz (1892) erected *Phyllocharis* with *tagis* as the genotype to contain all of the species here placed in the genus *Euchloë*. This genus is a homonym of *Phyllocharis* Dalman (1824). The species here included in *Elphinstonia* appear to the writer well worthy of subgeneric distinction from the other members of *Euchloë*, because of the characters cited in the subgeneric description.

The male genitalia show very distinct specific differences between *tagis* and *charlonia*. Between the species of the subgenus *Euchloë* these structures show less marked specific differences, with the exception of *belemia* (figs. 10-12). The venation is often exceedingly variable, and studied by itself would mean little. As an example of this fact the writer has a very large series of *E. ausonides coloradensis*, all of which were taken in one field within a period of four days. From this series he can pick out specimens which, under previous systems of classifying the *Euchloë* genera by venation alone, would belong in at least three genera. Several of these specimens have only four radials, and one has five on one side and four on the other, with no other evidence of distortion. Surely so variable a character is not worthy

of use for generic classification, especially when contrasted with characters as constant as those shown by the genitalia.

#### PHYLOGENY OF GENERA.

It is evident that phylogenetic work based on the venation of the *Euchloini* is not to be taken very seriously. Attempts at such work have indeed produced strange results, as for example when Tutt (1894b) postulated a rather close relationship between the *Euchloini* and *Leucophasia*, a genus which undoubtedly belongs in the *Dismorphiinae*. In this respect the work of Cockerell (1889), Dyar (1894) and Tutt (1894a) is also to be noted.

The great amount of variation found in the venation does, however, point to the fact that the *Euchloini* must occupy more or less of an intermediate position between groups which have a relatively stable primitive venation and other groups which possess a stable specialized venation.

The possession of a clasper in the male genitalia may be safely regarded as primitive. In this respect the *Euchloini*, together with the genera *Cathaemia*, *Mylothris*, *Hebomoia*, *Hesperocharis* and *Eroessa*, differ from the rest of the *Pieridae*. Of these five genera, *Cathaemia*, *Hebomoia* and *Hesperocharis* possess a *scaphium*, or scaphium-like structure, which is very much like a structure found in many *Papilionidae* and *Nymphalidae*. *Eroessa* shows the closest relationship to the *Euchloini* in every respect. The pupa of *Hebomoia* appears to be very similar to the *Euchloine* pupa. That of *Mylothris* is entirely different, and shows a relationship to *Pieris*. The writer considers that *Eroessa*, *Hesperocharis* and *Hebomoia* are closely related to the *Euchloini*, but that the similarity of *Mylothris* and *Cathaemia* in possessing a clasper is not to be regarded as evidence of any close relationship.

The pupa of the *Euchloini*, as pointed out by Tutt (1894), must be considered as highly specialized because of its extreme rigidity.

Within the *Euchloini* a fairly close correlation is evident between reduction in venation and reduction in genitalia. The species of *Euchloë* which have the most complicated genitalia all possess five radials except in abnormal cases. The species of *Elphinstonia* likewise possess five radials, but the genitalia show a certain amount of reduction in the *dorsal spine* of the harpé. The species of *Zegrís* possess five radials, but the dorsal spine is still further reduced. In *Microzegrís pyrothoë* only four radials occur, and the dorsal spine is greatly reduced so that the genitalia ap-

proximate those of *Falcapica* and *Anthocharis*. In these two latter genera the genitalia are very simple, a simplicity often correlated with the loss of  $R_5$ . The writer therefore believes that the trend of development in the *Euchloini* has been from a more complicated genitalic structure to a simpler one, and from the possession of five radials to the possession of only four. One would, of course, expect the groups to show evidence of sidewise development from the main line of the development of the group, and as such may be regarded the *basal prong of the penis of Elphinstonia*, the extremely short *saccus* of *Zegris*, the falcate apex of the primary of *Falcapica*, and many minor structures. If *Hebomoia* and *Eroessa* are postulated as ancestral forms then the loss of the orange patch on the primary in *Euchloë* and *Elphinstonia* must represent a "sidewise specialization" in those groups, as must the development of the yellow ground color in *charlonia* and its allies. It is all pure speculation, in which one author's guess is quite as good as another's.

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## PLATE VI.

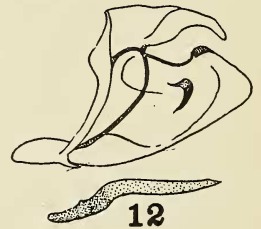
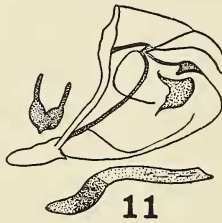
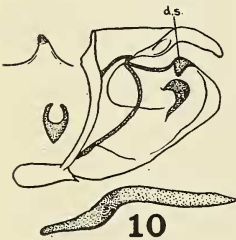
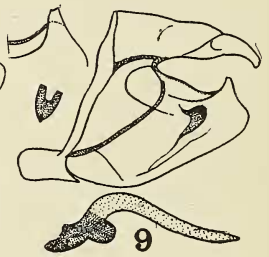
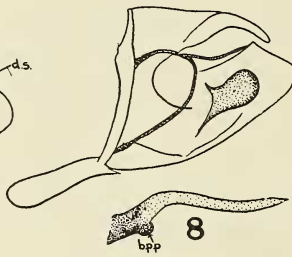
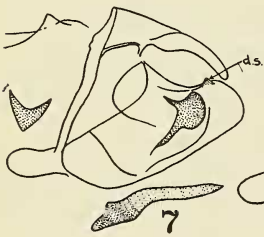
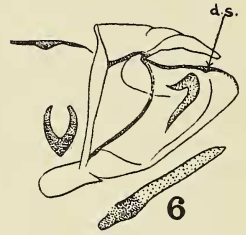
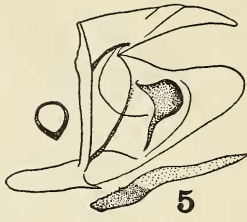
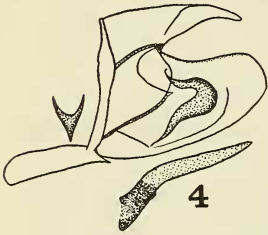
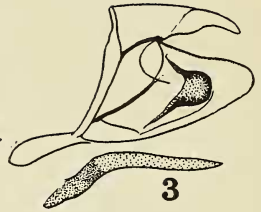
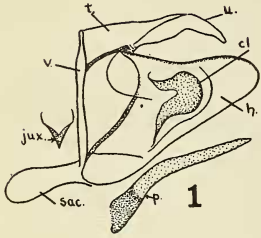
## EXPLANATION OF FIGURES.

- Fig. 1. Lateral aspect, male genitalia, *Anthocharis* (*Anthocharis*) *cardamines* L. with left harpé removed, lateral aspect of penis below, caudal aspect of juxta at left.
- Fig. 2. Lateral aspect of male genitalia of *Anthocharis* (*Anthocharis*) *eupheno* L. with left harpé removed, lateral aspect of penis below, caudal aspect of juxta at left.

- Fig. 3. Lateral aspect of male genitalia of *Anthocharis (Anthocharis) cethura* Felder with left harpé removed, lateral aspect of penis below.
- Fig. 4. Lateral aspect of male genitalia of *Anthocharis (Falcapica) genutia* Fabr. with left harpé removed, lateral aspect of penis below, caudal aspect of juxta at left.
- Fig. 5. Lateral aspect of male genitalia of *Anthocharis (Falcapica) scolymus* Butler with left harpé removed, lateral aspect of penis below, caudal aspect of juxta at left.
- Fig. 6. Lateral aspect of male genitalia of *Zegrís (Microzegrís) pyrothoë* Eversm. with left harpé removed, lateral aspect of penis below, lateral aspect, enlarged, of dorsal spine (above) and caudal aspect of juxta (below) at left.
- Fig. 7. Lateral aspect of male genitalia of *Zegrís (Zegrís) eupheme* Esper with left harpé removed, lateral aspect of penis below, lateral aspect, enlarged, of dorsal spine (above) and caudal aspect of juxta (below) at left.
- Fig. 8. Lateral aspect of male genitalia of *Euchloë (Elphin-tonia) tagis bellezina* Boisd. with left harpé removed, lateral aspect of penis below.
- Fig. 9. Lateral aspect of male genitalia of *Euchloë (Elphin-tonia) charlonia* Donzel with left harpé removed, lateral aspect of penis below, lateral aspect, enlarged, of dorsal spine (above) and caudal aspect of juxta (below) at left.
- Fig. 10. Lateral aspect of male genitalia of *Euchloë (Euchloë) belemia* Esper with left harpé removed, lateral aspect of penis below, lateral aspect, enlarged, of dorsal spine straightened dorsad (above) and caudal aspect of juxta (below) at left.
- Fig. 11. Lateral aspect of male genitalia of *Euchloë (Euchloë) belia* Cramer with left harpé removed, lateral aspect of penis below, caudal aspect of juxta at left.
- Fig. 12. Lateral aspect of male genitalia of *Euchloë (Euchloë) olympia* Edwards with left harpé removed, lateral aspect of penis below.

EXPLANATION OF ABBREVIATIONS.

- b.p.p. = basal prong of penis  
cl. = clasper  
d.s. = dorsal spine of harpé  
h. = harpé  
jux. = juxta  
p. = penis  
sac. = saccus  
t. = tegumen



u. = uncus

v. = vinculum

In preparing genitalia and drawing them with a projection apparatus a certain amount of distortion cannot be avoided. The efforts of the author have been firstly to have as little distortion as possible, and secondly to have what distortion is present affect the specimens in the same manner. For the sake of simplicity the setae, hairs and scales on the harpés have been omitted. In some cases these appear to offer specific characters.

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### THE JAPANESE BEETLE ON STATEN ISLAND.

BY WM. T. DAVIS, Staten Island, N. Y.

On the 31st of August, 1928, Mr. Charles W. Leng found a Japanese beetle (*Popillia japonica* Newman) in the Museum of the Staten Island Institute of Arts and Sciences, that had some time previously flown to one of the windows and died on the ledge where the upper and lower sashes come together. This specimen is recorded in the Proceedings of the Staten Island Nature Club for September 22, 1928.

In 1929 Carol Baumann, 378 St. Mark's Place, brought two of the beetles to the Museum; one collected July 30 and the other on September 5.

On August 26, 1929, K. Kessig brought another specimen to the Museum, collected this time at 406 St. Mark's Place. As three living individuals came from that general locality in Tompkinsville, it would appear that the beetle was not uncommon somewhere in the vicinity.

A fifth specimen which may, however, have been imported in fruit or vegetables, was found in a grocery store in Tompkinsville on August 29, 1929.